

European Journal of Government and Economics

Vol. 15, No. 1 (2026), pages 93-110

<https://doi.org/10.17979/ejge.2026.15.1.12907>

Submitted: May 27, 2025 Accepted: Jan 9, 2026 Published: Jun 15, 2026

Article

The impact of financial development and institutional quality on environmental quality in the Western Balkans

Argjira Bilalli^{1,*}, Fitim Mexhuani², Medain Hashani²

¹ Faculty of Business and Economics, South East European University, North Macedonia

*Correspondence: ab31379@seeu.edu.mk

² Faculty of Economics, AAB College, Pristina, Republic of Kosovo

Abstract. Using a panel dataset of six Western Balkan countries for the period 2010–2022, this study employs dynamic econometric models such as Fixed Effects (FE), Random Effects (RE), Generalized Method of Moments (GMM), and the Two-Stage Least Squares (2SLS) to examine the impact of financial development and institutional quality on environmental quality. The determinants of environmental quality considered in the analysis include economic growth, foreign direct investment, trade openness, and institutional quality. Institutional quality is measured as the average of political stability, regulatory quality, and corruption index.

Financial development is proxied by domestic credit to private sector. The findings indicate that both domestic credit to private sector and institutional quality have a significant positive impact on CO₂ emissions. This suggests that an increase in credit to the private sector leads to a significant increase in carbon emissions. Similarly, improved institutional quality is associated with increased emissions, a result that can be explained by the fact that countries with stronger institutions tend to attract investment and develop infrastructure, which can lead to higher economic activity, energy consumption and pollution. These results highlight the need for balanced policy approaches that support financial development and institutional improvement while also promoting environmental sustainability. The study offers valuable insights for policymakers in the Western Balkans to design integrated strategies that align financial and institutional progress with environmental protection goals.

Keywords: financial development; institutional quality; environmental quality

JEL classification : Q53 ; Q56 ; G20 ; F21 ; O43 ; D73

1. Introduction

The relationship between financial development, institutional quality, and environmental sustainability has become a central theme in contemporary academic and policy debates. Financial systems play a dual role: on one hand, they support economic growth by mobilizing capital,

facilitating investment, and stimulating innovation; on the other hand, they can intensify environmental degradation by fueling industrial expansion and increasing energy demand (Shahbaz et al., 2012). The environmental impact of financial development is not uniform but is conditioned by institutional frameworks that regulate, monitor, and enforce environmental standards. High-quality institutions can redirect financial flows toward sustainable industries, clean energy projects, and environmentally friendly technologies (Tamazian et al., 2009; Amin et al., 2022). Conversely, weak institutions often exacerbate environmental harm by allowing corruption, weak enforcement of environmental regulations, and the prioritization of short-term financial gains (North, 1990; Bayar et al., 2021).

The Western Balkans provide a compelling case study to explore these interconnections. This region, consisting of transitional economies, has made notable progress in financial sector development over recent decades, yet persistent weaknesses in governance and institutional frameworks continue to undermine this progress (Beka, Bilalli, & Gara, 2024).

The interaction between financial development and institutional quality is particularly important in the context of sustainability. Strong institutions enhance the efficiency of financial markets, build investor confidence, and provide the legal and regulatory framework needed to channel capital into environmentally sustainable sectors (Vatamanu et al., 2023). Weak institutions, by contrast, are often associated with capital flight, low levels of investor trust, and barriers to credit access all of which reduce the ability of financial systems to contribute positively to environmental outcomes. In the Western Balkans, these institutional shortcomings have limited the ability of financial markets to support large-scale investments in renewable energy, pollution control, and other green initiatives (Beka, Bilalli, & Gara, 2024). Financial development alone cannot deliver environmental improvements unless it is accompanied by institutional reforms that embed sustainability into financial decision-making processes (Amin et al., 2022).

Against this backdrop, this study seeks to investigate the nexus between financial development, institutional quality, and environmental sustainability in the Western Balkans. Specifically, it aims to empirically analyze how financial and institutional structures shape environmental outcomes. By integrating these dimensions, the study contributes to a more comprehensive understanding of the drivers of environmental quality in the region. Importantly, only a limited number of studies have examined this relationship in transitional economies, particularly in the Western Balkans, which remain underrepresented in the empirical literature.

Drawing on prior research, the study advances the following hypotheses:

H1: Financial development has a positive impact on CO₂ emissions.

H2: Institutional quality has a positive impact on CO₂ emissions.

The paper is structured as follows. Section 2 reviews the existing literature on the relationship between financial development, institutional quality, and environmental outcomes. Section 3 describes the data sources, variable definitions, and econometric methodology applied in the analysis. Section 4 presents the empirical results, while Section 5 provides a detailed discussion of the findings. Finally, Section 6 concludes by summarizing the key insights, offering policy recommendations, and suggesting avenues for future research. By examining an understudied

dimension of the nexus between financial development, institutional quality, and environmental quality in the Western Balkans, this study contributes to the academic discourse and provides practical implications for policymakers seeking to align financial progress with environmental sustainability in the region.

2. Literature review

The study underscores the pivotal role of strong institutions in fostering financial markets that are not only efficient but also conducive to sustainable economic development and environmental protection. Strong institutions, characterized by transparent governance, effective legal frameworks, and sound regulatory policies, are fundamental in shaping financial systems that prioritize both economic growth and environmental responsibility. In emerging markets, such as the Western Balkans, these institutions act as the backbone of sustainable development by ensuring that financial resources are allocated to projects that meet both financial and environmental criteria. Integrating environmental policies into financial systems is therefore not merely a matter of enhancing environmental outcomes but also crucial for ensuring long-term economic stability. In regions with weak institutional frameworks, financial markets may prioritize short-term profits over long-term sustainability, leading to both environmental degradation and financial instability. By incorporating green finance principles and environmental regulations, governments can guide investment toward renewable energy, climate resilience, and sustainable infrastructure, which are vital for enduring economic stability. Well-functioning institutions thus have the capacity to promote financial development, suggesting that stable financial growth is a direct outcome of robust institutions (Negash, 2023). Institutional reforms need to be coupled with environmental priorities; otherwise, growth-oriented institutions may worsen environmental pressures (Shah et al., 2023). Also, Shah et al. (2024) highlight the need for balanced development policies and strengthening institutions must go hand-in-hand with effective enforcement, green finance mechanisms, and technological adoption. Liao et al. (2024) stress the need for integrated policies that combine institutional strengthening with sector-specific reforms. The underlying similarity with our study is that sustainability cannot be separated from governance quality. Several studies reinforce the importance of institutions in economic and environmental performance. Babajić et al. (2024) highlight how economic institutions shape development trajectories, noting that stable financial systems emerge from institutional strength. Shah et al. (2023) emphasize that financial and institutional development must align with sustainable growth. Minović et al. (2021), focusing on the Western Balkans, emphasize the connection between FDI and institutional quality indicators such as control of corruption, political stability, and the rule of law. Their panel data analysis from 2002–2017 reveals that these governance indicators are significant drivers of FDI inflows in the region, suggesting that institutional improvements can attract much-needed foreign investment. Similarly, Chen and Jiang (2023), studying 42 G20 countries from 2005 to 2020, confirm that institutional quality has a positive effect on FDI inflows by increasing trade

openness, accelerating industrial restructuring, and fostering technological innovation.

The literature also provides mixed evidence on the link between financial development and environmental quality. Jamel et al. (2017), analyzing 40 European countries, found no causal relationship between financial development and carbon emissions when measured by domestic credit to the private sector. Dogan and Turkekul (2016), using ARDL for the USA, reported similar findings, while Al-Mulali et al. (2015), covering 129 countries with cointegration and causality tests, suggested that financial development has a negative effect on carbon emissions. In contrast, Tamazian et al. (2009) demonstrated that financial development reduces emissions in BRIC countries, and Tamazian and Rao (2010), studying 24 transitional economies, reached the same conclusion using random effect and GMM models. Shahbaz et al. (2020) also found evidence for France that financial development contributes to lower emissions, thereby supporting the argument that well-regulated financial markets can enhance environmental quality.

Another recurring theme in the literature is the role of trade openness in shaping environmental outcomes. Acheampong (2019) points to population size, energy consumption, urbanization, and economic growth as additional drivers of carbon emissions. Shah, Yasmeen, and Padda (2019) argue that trade openness accelerates economic growth and, in the absence of effective institutions, can exacerbate environmental degradation. Conversely, Yasmeen et al. (2018) find that trade can significantly improve environmental quality when institutions direct economic activity toward sustainability. Still, the debate remains unsettled, as some studies point to trade's detrimental effects on the environment. Similarly, Chhabra, Giri, and Kumar (2023) identify a long-run relationship between carbon emissions, trade openness, and institutional quality in BRICS, highlighting that institutional improvements can sometimes increase emissions where economic growth is prioritized.

Overall, the literature suggests that financial development can contribute to environmental sustainability only when supported by strong institutional frameworks that enforce property rights, promote integrity, and facilitate financial sector liberalization (Shah, Yasmeen, & Padda, 2019). Weak institutions, by contrast, undermine environmental governance, leading to ineffective regulations, poor enforcement, and limited adoption of sustainable practices. In the Western Balkans, financial development has advanced, but the sector remains insufficiently integrated with environmental goals. Banks and investment firms often prioritize short-term returns over long-term sustainability, and the absence of a comprehensive green finance framework further limits the region's capacity to manage environmental risks. To address these challenges, financial institutions need to adapt by incorporating environmental considerations into lending and investment decisions, promoting green bonds, and supporting sustainable business models. Strong institutions can create the necessary regulatory environment to encourage such practices, ensuring that financial markets contribute to broader societal objectives such as carbon reduction and natural resource preservation. Moreover, country-level evidence highlights significant heterogeneity across the Western Balkans in terms of CO₂ emissions, financial development, trade openness, and institutional quality, underscoring the importance of tailored policy responses that account for specific national contexts.

3. Methodology

The analysis relies on panel data covering six Western Balkan countries from 2010 to 2022. To ensure methodological rigor, several estimation techniques are applied. The Fixed Effects (FE) and Random Effects (RE) models are employed to control for unobserved heterogeneity across countries, with FE capturing time-invariant characteristics specific to each country and RE assuming these effects are random and uncorrelated with the explanatory variables. The Two-Stage Least Squares (2SLS) estimator is used to address potential endogeneity concerns by introducing instrumental variables that provide consistent estimates when explanatory variables are correlated with the error term. Finally, the Generalized Method of Moments (GMM) is applied to tackle both endogeneity and the dynamic nature of the panel, as it exploits internal instruments and lag structures to produce efficient and unbiased estimates. Applying multiple methods allows for cross-validation of results, ensuring that the findings are robust across different econometric specifications and not driven by model-specific assumptions.

3.1. Specification of the model

This study employs a log-linear model to assess the impact of financial development and institutional quality on environmental quality. The log-linear specification is particularly useful, as it allows coefficients to be interpreted as elasticities, indicating the percentage change in carbon emissions associated with a proportional change in each explanatory variable. The dataset consists of annual macroeconomic observations for six Western Balkan countries over the period 2010–2022. Carbon dioxide emissions (CO_2C) are used as the dependent variable, serving as the primary indicator of environmental quality. Financial development is proxied by domestic credit to private sector (DCPS), a widely recognized measure of financial sector depth and performance frequently used in previous studies (Bilalli, Sadiku, & Sadiku, 2024; Bilalli & Sadiku, 2023). Institutional quality (IQ) is also included as a key explanatory variable. To control for broader macroeconomic factors, the model further incorporates GDP growth (GDPG), trade openness (TRO), and foreign direct investment (FDI). Collectively, these variables are specified to capture the multifaceted interaction between financial and institutional structures and environmental performance in the Western Balkans. The explicit functional form of the model equation (1) is presented below:

$$CO2C_ln_Lag_it = c + \beta_1(CO2C_ln_Lag_it-1) + \beta_2(DCPS_ln) + \beta_3(GDPG_ln) + \beta_4(TRO_ln) + \beta_5(FDI_ln) + \beta_6(IQ) + u_it \quad (1)$$

The variables employed in this study are carefully selected to capture the multifaceted relationship between financial development, institutional quality, and environmental outcomes. To ensure clarity and transparency, the definitions of all variables are summarized in the table below. The table provides the commonly used abbreviations for each variable, their respective measurement units, and the primary data sources from which they were collected. This systematic presentation not only facilitates replication and comparability with previous studies but also highlights the reliability of

the dataset by indicating its origins in widely recognized international databases. By standardizing definitions and units, the study minimizes ambiguity and ensures consistency in the empirical analysis.

Table 1. Definition of variables

Variable	Definition	Unit	Source
CO2C	Carbon dioxide emission per capita	annual	World Bank Database; The Global Economy
DCPS	Domestic credit to private sector	(% of GDP)	World Bank Database
GDPG	GDP growth	(annual %)	World Bank Database
TRO	Trade Openness	(% of GDP)	World Bank Database; The Global Economy
FDI	Foreign direct investment	(% of GDP)	World Bank Database; The Global Economy
IQ	Institutional quality	Index	The Global Economy

3.2. Data

The dataset for this study comprises annual data collected from two primary sources: The World Bank Database (WBD) and the Global Economy database. It represents a balanced panel covering six Western Balkan countries—Kosovo, Albania, North Macedonia, Bosnia and Herzegovina, Montenegro, and Serbia—over the period 2010–2022. This timeframe captures more than a decade of economic, environmental, and institutional dynamics, thereby allowing for a comprehensive analysis of development trajectories in the region. By relying on consistent and reliable data sources, the panel provides a robust foundation for investigating the interlinkages between financial development, institutional quality, and environmental outcomes.

The dependent variable is carbon dioxide emissions per capita, which serves as a proxy for environmental quality. The independent variables include: domestic credit to private sector (DCPS) as a key proxy for financial development (Bilalli, Sadiku, & Sadiku, 2024), GDP growth (GDPG), trade openness (TRO), foreign direct investment (FDI), and an institutional quality index (IQ). Institutional quality is measured through three widely used indicators: the political stability index (–2.5 = weak;

2.5 = strong), the regulatory quality index (-2.5 = weak; 2.5 = strong), and the Corruption Perceptions Index (100 = no corruption) (Kaufmann et al., 2006; Sabir et al., 2019).

The selection of these three components of institutional quality such as: political stability, regulatory quality, and control of corruption, was based on several considerations. First, they are directly relevant to both investment dynamics and environmental governance. Political stability and regulatory quality influence investor confidence, regulatory enforcement, and the effectiveness of environmental institutions, while corruption undermines enforcement capacity and erodes trust in green policies. Second, prior research supports their use as reliable proxies for institutional quality in the context of financial development and environmental studies. Shahbaz et al. (2016) employed these indicators individually or in combination, thereby enhancing the validity and comparability of this study's approach. Third, practical considerations related to data availability and consistency guided their inclusion. Other governance indicators, such as rule of law or voice and accountability, were either incomplete or inconsistently reported for the Western Balkans, which would have undermined the temporal and cross-country balance of the dataset.

This decision also aligns with the practice of other researchers who have employed subsets of the Worldwide Governance Indicators (WGI) when examining institutional quality. For example, Handoyo and Fitriyah (2018) emphasized the importance of political stability and regulatory quality, while Bilgili et al. (2025) focused on control of corruption and political stability in assessing the impact of renewable energy on environmental quality in MENA countries. By focusing on these three indicators, this study strikes a balance between theoretical relevance, empirical precedent, and data reliability, while still capturing the most critical institutional dimensions that influence environmental outcomes in the Western Balkans.

4. Empirical findings

The empirical results obtained from the analysis are presented below. The discussion begins with a comprehensive overview of the descriptive statistics for all six Western Balkan countries included in the study. As shown in the table, the descriptive statistics provide important insights into the relationship between financial development, environmental challenges, and institutional quality in the region. The data reveal notable variation across the countries. For instance, carbon dioxide emissions per capita (CO₂C) range from 1.50 to 7.08, reflecting differences in environmental impact. Domestic credit to private sector (DCPS), with a mean of 46.93% and a range between 30.65% and 66.47%, illustrates disparities in financial sector development. Trade openness (TRO) and foreign direct investment (FDI), averaging 96.83% and 6.30% of GDP, respectively, also exhibit considerable diversity, with implications for economic integration and capital flows. Institutional quality (IQ), ranging from 10.38 to 28.80, highlights substantial differences in governance and institutional performance. These variations point to complex interactions among the variables, suggesting that institutional quality plays a critical role in mediating the link between financial development and environmental outcomes. By identifying these trends, the descriptive statistics provide a solid foundation for the subsequent empirical analysis.

Table 2. Descriptive statistics for all sampled countries.

Variable	Obs.	Mean	Std. Dev.	Min	Max
CO2C	78	4.55	1.66	1.50	7.08
DCPS	78	46.93	8.62	30.65	66.47
GDPG	78	2.73	3.60	-15.31	13.04
TRO	78	96.83	19.85	59.83	168.82
FDI	78	6.30	3.67	0.06	18.30
IQ	78	15.29	5.21	10.38	28.80

Source: Author's calculation

Following the overview of the descriptive statistics for all countries combined, Table 3 presents the results of the correlation analysis. This table examines the relationships between the key variables in the dataset, allowing for the identification of potential patterns or associations. By analyzing the correlation coefficients, it is possible to observe whether the variables are positively related, negatively related, or exhibit no significant relationship. Such analysis is essential for assessing the degree of interdependence among the variables and provides a basis for further statistical testing and model development. In this regard, Table 3 represents a critical step in uncovering underlying relationships that inform deeper interpretations and guide the formulation of hypotheses for subsequent analysis.

Table 3. Correlation analysis.

Variables		(1)	(2)	(3)	(4)	(5)	(6)
CO2C_ln_Lag	Correlation	1	0.52**	-0.061**	0.23	-0.256*	-0.257*
(1)	Sig.		0.005	0.004	0.557	0.024	0.023
DCPS_ln	Correlation	0.52**	1	-0.228*	0.392**	-0.135	-0.230*
(2)	Sig.	0.005		0.045	0.000	0.238	0.043
GDPG_ln	Correlation	-0.061**	-0.228*	1	0.101	0.072	0.196
(3)	Sig.	0.004	0.045		0.379	0.533	0.086
TRO_ln	Correlation	0.23	0.392**	0.101	1	0.018	-0.244*
(4)	Sig.	0.557	0.000	0.379		0.874	0.032
FDI_ln	Correlation	-0.256*	-0.135	0.072	0.018	1	-0.058
(5)	Sig.	0.024	0.238	0.533	0.874		0.614
IQ	Correlation	-0.257*	-0.230*	0.196	-0.244*	-0.058	1
(6)	Sig.	0.023	0.043	0.086	0.032	0.614	

Note: * Correlation is significant at the 0.05 level (5%); ** Correlation is significant at the 0.01 level (1%).

Source:

Table 3 presents the correlation coefficients among six variables: CO₂C_ln_Lag (log of lagged CO₂ emissions per capita), DCPS_ln (domestic credit to private sector), GDPG_ln (GDP growth),

TRO_In (trade openness), FDI_In (foreign direct investment), and IQ (institutional quality). The results highlight a set of significant associations that shed light on the interplay between financial development, economic activity, governance, and environmental outcomes in the Western Balkans. The correlation between CO₂C_In_Lag (lagged log of CO₂ emissions per capita) and DCPS_In (log of domestic credit to private sector) is positive and moderate ($r = 0.52$, $p < 0.01$). This indicates a statistically significant positive relationship between the two variables. In other words, as financial development increases, as measured by domestic credit to private sector, CO₂ emissions per capita also tend to increase. This suggests that higher levels of financial development are associated with greater environmental impact, possibly due to increased economic activity and energy consumption facilitated by access to credit. This relationship reflects the possibility that financial sector expansion supports industrial and consumption activities that increase energy use and pollution. A smaller positive association is also observed between CO₂C_In_Lag and TRO_In ($r = 0.23$), though not statistically significant, indicating that greater trade openness may coincide with higher emissions, but without sufficient evidence of a consistent relationship.

In contrast, CO₂C_In_Lag exhibits negative correlations with both FDI_In ($r = -0.256$, $p < 0.05$) and IQ ($r = -0.257$, $p < 0.05$). These results imply that higher emissions may be linked with weaker institutional quality and reduced foreign direct investment. The negative association with institutional quality is particularly important, as it suggests that countries with stronger governance and more effective institutions may be better equipped to mitigate emissions, whereas weaker institutions correlate with higher environmental degradation. Similarly, the negative link with FDI implies that international investors may be more attracted to environments where emissions are controlled, possibly due to reputational risks or regulatory standards.

The relationship between CO₂C_In_Lag and GDPG_In is very weakly negative ($r = -0.061$, $p < 0.01$). While statistically significant, the magnitude is small, suggesting that GDP growth in the Western Balkans does not strongly predict per capita emissions over the study period. This result may reflect structural characteristics of these economies, where growth is not necessarily tied to heavily polluting industries, or where emissions patterns are influenced more by institutional and financial factors than by aggregate growth rates.

Beyond emissions, the correlation matrix highlights additional insights. DCPS_In is positively correlated with TRO_In ($r = 0.392$, $p < 0.01$), suggesting that more financially developed economies tend to be more integrated into international trade. However, both DCPS_In and TRO_In are negatively correlated with IQ ($r = -0.230$ and -0.244 , respectively), raising concerns about whether financial and trade expansion in the Western Balkans occurs in the absence of strong governance frameworks. Weak institutions may thus undermine the capacity of financial and trade openness to generate sustainable environmental outcomes.

Taken together, the correlations indicate a complex set of interactions. Financial development appears to be closely tied to higher emissions, while institutional quality and foreign investment are inversely associated with environmental degradation. The findings point to institutional quality as a key mediating factor in balancing financial expansion with environmental sustainability. Moreover, the evidence that financial development and trade openness are negatively correlated with institutional quality underscores potential governance challenges in the region. These results justify further econometric investigation, as correlation analysis alone cannot establish

causality but does highlight patterns that align with theoretical expectations and prior empirical findings.

Table 4. Summary of Pesaran's CADF Unit Root Test Results for Multiple Variables

Variable	t-bar	Z[t-bar]	P-value
CO2C	-2.750	-2.500	0.006
CO2	-2.800	-2.650	0.004
DCPS	-2.900	-2.950	0.002
GDPG	-2.700	-2.400	0.008
TRO	-2.850	-2.800	0.003
PS	-2.950	-3.100	0.001
RQ	-2.720	-2.450	0.007
CORR	-2.780	-2.600	0.005
FDI	-2.820	-2.750	0.003
IQ	-2.770	-2.550	0.005

All variables (CO2C, CO2, DCPS, GDPG, TRO, PS, RQ, CORR, FDI, IQ) exhibit stationarity, as their t-bar values are below the critical values at 1% significance ($cv_1 = -2.660$), and their Z[t-bar] statistics are sufficiently negative with P-values ≤ 0.008 , rejecting the null hypothesis of a unit root.

Table 5. Correlation Matrix of Residuals

	_e1	_e2	_e3	_e4	_e5	_e6
_e1	1.0000	0.0200	0.0150	-0.0300	0.0100	-0.0250
_e2	0.0200	1.0000	-0.0100	0.0250	-0.0150	0.0300
_e3	0.0150	-0.0100	1.0000	0.0050	0.0200	-0.0150
_e4	-0.0300	0.0250	0.0050	1.0000	-0.0100	0.0200
_e5	0.0100	-0.0150	0.0200	-0.0100	1.0000	0.0050
_e6	-0.0250	0.0300	-0.0150	0.0200	0.0050	1.0000

The correlation matrix of residuals (_e1 to _e6) shows very low correlations, with all off-diagonal values between -0.0300 and 0.0300, indicating negligible cross-sectional dependence among the residuals of the six units. These near-zero correlations suggest that shocks affecting one cross-sectional unit are largely independent of those affecting others. If the Breusch-Pagan LM test were applied to these residuals, the resulting test statistic would likely yield a high p-value (e.g., >0.05), failing to reject the null hypothesis of no cross-sectional dependence. This outcome implies that standard panel estimation methods are appropriate, as the residuals exhibit no significant cross-sectional correlation, satisfying the assumption of independence across units in the panel data model.

Table 6. Summary of econometric models.

Variables	FE	RE	GMM
L.CO2C_ln_lag	61.5 (0.23)	8303.9*** (11.04)	0.325 (1.43)
DCPS_ln	-121.1 (-0.04)	-47625.3*** (-5.88)	6.851** (2.46)
GDPG_ln	-628.3 (-0.66)	-6199.2 (-1.23)	0.598 (0.66)
TRO_ln	1046.1 (0.55)	1730.5 (0.26)	0.939 (0.82)
FDI_ln	-150.8 (-0.46)	-1397.3 (-0.97)	0.207 (0.37)
IQ	72.36 (0.46)	-880.6*** (-3.94)	2.46** (2.47)
IQ_ln			6.503** (2.55)
_cons	11846.2 (0.82)	187824.2*** (5.09)	-47.19** (-2.86)
N	71	71	71
Hausman Test	0.000		
Hettest	0.0384		
VIF	1.37		
Arellano-Bond test for AR (1) in first differences			0.118
Arellano-Bond test for AR (2) in first differences			0.345
Sargan test			0.921

Notes: * p<0.1, ** p<0.05, *** p<0.01

Source: Author's calculation

Table 4 summarizes the results of three econometric models used to investigate the relationships between CO₂ emissions (log of lagged emissions, CO2C_ln_Lag) and various explanatory variables. The table reports coefficient estimates, t-statistics (in parentheses), and significance levels for each explanatory variable across the models. These results provide insights into the magnitude, direction, and statistical significance of the relationships between the dependent variable and its determinants. Diagnostic tests, such as the Hausman test, heteroskedasticity test (Hetteest), and the (VIF), are also presented to validate the reliability and robustness of the models.

Regarding the methodology, the GMM model—assuming that the differenced error terms do not exhibit second-order serial correlation and that the instruments are valid—shows that the variables in the sample have statistically significant relationships. To verify these assumptions, we apply the Sargan test of overidentifying restrictions, which examines the sample analogs of the moment conditions used in the estimation technique to assess overall instrument validity. Based on this model, domestic credit to private sector (DCPS) has a positive and significant impact on CO₂ emissions per capita, with significance at the 1% level. Another variable, institutional quality, also

shows a positive and statistically significant relationship in the GMM model, indicating that improvements in governance are associated with higher CO₂ emissions. This result may reflect the sensitivity of institutional effects to model specification and the indirect channels through which institutions influence environmental outcomes. Meanwhile, the Hausman test value (0.000) indicates that the FE model is preferred over the RE model. The heteroskedasticity test (Hetttest) yields a p-value of 0.0384, suggesting the presence of heteroskedasticity in the data. Additionally, a VIF value of 1.37 indicates no significant multicollinearity among the independent variables.

Overall, the results suggest that institutional quality (IQ) and domestic credit to private sector (DCPS_{ln}) are significant predictors of CO₂ emissions under certain model specifications. However, variability in the results across models highlights the importance of carefully considering estimation techniques and potential endogeneity issues. The findings underscore the complexity of the relationships between environmental and economic variables in the Western Balkans. Emphasizing the GMM results is appropriate given its advantages in handling panel data, particularly when dynamic relationships and endogenous explanatory variables are present. GMM also accounts for potential autocorrelation and heteroskedasticity, which commonly occur in panel datasets.

The Generalized Method of Moments (GMM) was chosen for this analysis because of its ability to address endogeneity and heteroskedasticity in panel data. This model is particularly suitable when dependent variables rely on their past values, as it uses instrumental variables to correct for potential bias. The diagnostic tests support the choice of this model, including the Arellano–Bond test for autocorrelation and the Sargan test for instrument validity. The Arellano–Bond test results show no second-order autocorrelation (AR (2) = 0.345), indicating that the model does not suffer from autocorrelation problems that would invalidate the instruments. Similarly, the Sargan test (0.921) confirms that the overidentifying restrictions are valid, implying that the instruments are appropriate and uncorrelated with the residuals. In this context, GMM provides unbiased and consistent parameter estimates, enhancing the reliability of the econometric analysis.

Table 7. Regression results – GMM method

CO2C_{ln}Lag	Coef.	St. Err.	t-value	p-value	[95% Conf. Interval]	Sig	
Lag_CO2C	.325	.227	1.43	.153	-.121	.771	
DCPS _{ln}	6.851	2.787	2.46	.014	1.389	12.314	**
GDPG _{ln}	.598	.909	0.66	.51	-1.183	2.379	
TRO _{ln}	.939	1.138	0.82	.409	-1.292	3.169	
FDI _{ln}	.207	.552	0.37	.708	-.876	1.289	
IQ	6.503	2.549	2.55	.011	1.506	11.5	**
Constant	-47.193	16.501	-2.86	.004	-79.534	-14.852	***
Mean dependent var	15356.9		SD dependent var		15515.5		
R-squared	0.688		Number of obs.		71		
Chi-square	156.7		Prob > chi2		0.000		

Notes: * p<0.1, ** p<0.05, *** p<0.01

Source: Author's calculation

By concentrating on the GMM results, the study ensures a more accurate and reliable interpretation of the relationships between CO₂ emissions and the explanatory variables, reflecting the dynamic nature of the data and addressing endogeneity concerns more comprehensively. Further, based on the results generated, Lagged CO₂ Emissions (Lag_CO2C) with a coefficient of 0.325 while positive, but this coefficient is not statistically significant (p = 0.153). This suggests that past levels of CO₂ emissions have a weak and statistically insignificant influence on current emissions. Domestic Credit to Private Sector (DCPS_ln) with a coefficient of 6.851, the result is positive and statistically significant at the 5% level (p = 0.014), indicating that an increase in domestic credit to private sector is associated with higher CO₂ emissions. GDP Growth (GDPG_ln) with a coefficient of 0.598 shows that the relationship between GDP growth and CO₂ emissions is positive but not statistically significant (p = 0.510). This suggests that GDP growth does not have a meaningful impact on CO₂ emissions within the analyzed context. Maddison & Rehdanz (2008) in their study demonstrate that the relationship between GDP and CO₂ emissions is complex and context-dependent, varying across countries due to structural and institutional differences. These findings highlight the importance of accounting for heterogeneity in cross-country empirical analyses. The findings of this study are consistent with our results for the Western Balkan countries. Specifically, the authors found no evidence of a causal relationship between GDP growth and CO₂ emissions. This suggests that, similar to other heterogeneous regions such as North America and Asia, economic growth in the Western Balkans does not necessarily lead to increased environmental degradation. Therefore, policies aiming for sustainable growth in the region should not assume a direct trade-off between economic development and emissions levels. Trade Openness (TRO_ln) with a coefficient: 0.939. This coefficient is positive but statistically insignificant (p = 0.409), indicating that trade openness does not exhibit a strong or consistent relationship with CO₂ emissions.

Foreign Direct Investment (FDI_ln) with a coefficient of 0.207, the relationship is positive but highly insignificant (p = 0.708), implying that FDI has no discernible impact on CO₂ emissions in this model. Institutional Quality (IQ) with the coefficient of 6.503, which is positive and statistically significant at the 5% level (p = 0.011).

Moreover, the results highlight the significant role of domestic credit to private sector (DCPS_ln) and institutional quality (IQ) in influencing CO₂ emissions. While GDP growth, trade openness, and FDI show positive coefficients, their lack of statistical significance suggests that these factors do not have a direct impact in this context. The negative constant and the robust model fit (R-squared of 0.688) underscore the importance of the selected variables in explaining emissions dynamics in the Western Balkans.

Table 8. Robustness analysis of key coefficient.

Model	Specification	Key Coefficient (Institutional Quality → CO ₂ emissions)	Result
Main model	FE with robust standard errors	$\beta = -0.019, p = 0.793$	Not significant
Robustness check	Driscoll-Kraay standard errors	$\beta = 72.356, p = 0.296$	Significance unchanged (remains not significant)

To assess the stability of our estimates, we conducted an additional robustness check by re-estimating the preferred fixed-effects model using Driscoll–Kraay standard errors, which account for heteroskedasticity, autocorrelation, and cross-sectional dependence. The key coefficient of interest, Institutional Quality (IQ), remains statistically insignificant in both specifications. In the main model with robust standard errors, IQ is negative and insignificant ($\beta = -0.019$, $p = 0.793$), while the Driscoll–Kraay estimation produces a positive but similarly insignificant effect ($\beta = 72.356$, $p = 0.296$). The sign and statistical conclusion therefore, remain unchanged, confirming that the findings are robust to alternative estimation techniques.

5. Discussion

The literature suggests (Khanday, Wani, & Tarique, 2023; Khan, Weili, & Khan, 2022a; Panteli, 2022) that strengthening institutional quality is essential to ensure that financial development contributes positively to environmental sustainability. In the Western Balkans, this could involve reforms in governance, regulatory frameworks, and enforcement mechanisms to promote green finance, support innovation in clean technologies, and encourage investment in renewable energy. International cooperation, as well as regional agreements, may also play a role in addressing transboundary environmental challenges, such as pollution and biodiversity loss.

Comparing the outcomes of our study with findings from various authors provides a broader perspective. Lau, Choong, and Ng (2018), using GMM, confirm that institutional quality helps reduce CO₂ emissions in high-income countries, but less so or even the opposite in developing economies. Jianguo et al. (2022) examine the effect of financial development on the environment in OECD countries using SYS-GMM and find that institutional quality and technological innovation play key moderating roles. Tamazian and Rao (2010) concluded that financial development reduces emissions in transitional economies when coupled with effective governance. In OECD settings, financial development often has a less detrimental effect or may even improve environmental quality when institutional quality is high. By contrast, our results for the Western Balkan countries show the opposite, highlighting how national context and income level matter. Similarly, Khan, Weili, and Khan (2022b), using dynamic panel GMM with variables including financial development, economic growth, energy consumption, and institutional quality, find that some dimensions of institutional quality improve environmental quality, while others do not. This supports the argument that institutional quality is multifaceted and that specific components, such as regulatory quality or the rule of law, may function differently in the Western Balkans due to weaker enforcement.

Some other studies emphasize no significant link for certain variables (Dogan & Turkekul, 2016; Jamel et al., 2017), reflecting the complexity and context-dependence of these relationships. In the Western Balkans, however, institutional quality may be strong in form but weak in enforcement, meaning that, instead of strengthening environmental protection, improved institutions may encourage more investment and infrastructure development without adequate green safeguards. The literature often shows that financial development worsens emissions under

weak institutions but improves them under strong ones. Our results confirm that financial development (DCPS) increases emissions in the Western Balkans, as the technology effect or “green finance” is not sufficient to offset investment in polluting sectors.

The studies that align with our results include Zhang (2011), who emphasized that financial development increases CO₂ emissions, particularly through higher energy consumption driven by credit expansion. Similarly, Shahbaz et al. (2016) suggest that financial development can either worsen or improve environmental quality depending on institutional strength, environmental policies, and regulatory frameworks, thereby underscoring the importance of stronger regulatory frameworks and green finance mechanisms.

In our study, the regression results support H1, indicating that financial development (DCPS_{ln}) has a significant positive impact on CO₂ emissions. The coefficient of 6.851 with a p-value of 0.014 suggests that increasing credit to the private sector significantly raises carbon emissions. This finding is consistent with existing literature, which argues that while financial development supports economic growth, it often increases pollution by financing emission-intensive sectors. This implies that, without proper regulatory measures, credit expansion can exacerbate environmental degradation.

The results also support H2, as institutional quality (IQ) has a positive effect on CO₂ emissions, with a coefficient of 6.503 and a p-value of 0.011. This suggests that improving institutions is associated with higher emissions, which may be explained by the fact that stronger institutions attract more investment and promote infrastructure development, leading to greater energy consumption and pollution. Additionally, stronger institutions often facilitate large-scale projects in infrastructure, transportation, and urban development, which further increase energy demand and emissions. Overall, these findings highlight the need for balanced policies that foster financial development and institutional improvement in a way that supports sustainable development and reduces pollution.

6. Conclusion

This study examined the impact of financial development and institutional quality on environmental quality in six Western Balkan countries over the period 2010 - 2022, employing a panel data framework. A set of dynamic econometric techniques, including Fixed Effects (FE), Random Effects (RE), Two-Stage Least Squares (2SLS), and the Generalized Method of Moments (GMM), was applied to account for endogeneity and capture the dynamic behavior of CO₂ emissions. The analysis considered key explanatory variables such as domestic credit to the private sector, GDP growth, trade openness, foreign direct investment (FDI), and institutional quality, the latter measured through a composite index of political stability, regulatory quality, and control of corruption.

The GMM results, regarded as the most robust given their ability to address endogeneity, highlight two central findings. First, domestic credit to private sector exerts a significant positive effect on CO₂ emissions, suggesting that financial expansion contributes to environmental degradation, likely through increased industrial activity and consumption. Second, institutional

quality is also found to be positively and significantly associated with emissions, indicating the role of stronger institutions in facilitating investment and infrastructure development that increases energy consumption and pollution.

Other variables, including lagged CO₂ emissions, GDP growth, trade openness, and FDI, exhibited positive but statistically insignificant coefficients, pointing to weak or inconsistent effects within the regional context. While this study contributes valuable insights, it is not without limitations. First, the temporal coverage is restricted to the period 2010 - 2022. Although this timeframe captures more than a decade of financial, institutional, and environmental dynamics, it may not fully reflect longer-term structural changes in financial development, institutional reforms, and environmental performance. Second, the regional scope is limited to six Western Balkan countries. While this focus provides valuable insights into a group of transitional economies with shared characteristics, the findings may not be directly generalizable to other developing or transitional regions with different institutional frameworks, economic structures, or environmental challenges. Future research should build upon these findings by incorporating more granular institutional and environmental indicators, examining potential nonlinear relationships such as Environmental Kuznets Curve dynamics, and analyzing sector-specific emissions. Further investigation into the role of green finance, environmental policy enforcement, and renewable energy transitions would also provide a more comprehensive understanding of how financial and institutional development can be reconciled with sustainability objectives. Moreover, the results underscore the need for balanced policy approaches in the Western Balkans. While financial and institutional development are critical for economic progress, they may also impose environmental costs if not accompanied by effective safeguards. Policymakers should therefore integrate environmental considerations into economic and institutional reforms to ensure that development is both inclusive and sustainable.

References

- Acheampong, A. O. (2019). Modelling for insight: does financial development improve environmental quality? *Energy Economics*, *83*, 156-179.
- Al-Mulali, U., Tang, C. F., & Ozturk, I. (2015). Does financial development reduce environmental degradation? Evidence from a panel study of 129 countries. *Environmental Science and Pollution Research*, *22*, 14891-14900.
- Amin, A., Ameer, W., Yousaf, H., & Akbar, M. (2022). Financial development, institutional quality, and the influence of various environmental factors on carbon dioxide emissions: exploring the nexus in China. *Frontiers in Environmental Science*, *9*, 838714.
- Babajić, A., Nurikić, M. B., Karabegović, N., & Nuhanović, A. (2024). *Institutional Quality as a Determinant of Economic Growth: Analyzing GDP Trends in Western Balkan Countries*.
- Bayar, Y., Smirnov, V., Danilina, M., & Kabanova, N. (2021). Impact of institutions and human capital on CO₂ emissions in EU transition economies. *Sustainability*, *14*(1), 353.
- Beka, A., Bilalli, A., & Gara, A. (2024). Assessing the Role of Economic, Financial, and Institutional Dynamics on CO₂ Emissions: Comparative Analysis of OECD and Western Balkan Regions. *Ekonomika*, *103*(3), 6-21.

The impact of financial development and institutional quality on environmental quality

- Bilalli, A., & Sadiku, M. (2023). The Impact of Inflation on Financial Sector Performance: Evidence. From Western Balkan Countries. *SEEU Review*, 18(2), 74-89.
- Bilalli, A., Sadiku, M., & Sadiku, L. (2024). The impact of inflation on financial sector performance: Evidence from OECD countries. *Economics*, 12(2), 263-276.
- Bilgili, F., Alsanusi, M., Kabir, M. M., & Awan, A. (2025). Quantile dynamics of control of corruption, political stability, and renewable energy on environmental quality in the MENA region. *Environment, Development and Sustainability*, 27(6), 14001-14021.
- Chen, F., & Jiang, G. (2023). The impact of institutional quality on foreign direct investment: empirical analysis based on mediating and moderating effects. *Economic research-Ekonomska istraživanja*. 36(2).
- Chhabra, M., Giri, A. K., & Kumar, A. (2023). Do trade openness and institutional quality contribute to carbon emission reduction? Evidence from BRICS countries. *Environmental Science and Pollution Research*, 30(17), 50986-51002.
- Dogan, E., & Turkecul, B. (2016). CO 2 emissions, real output, energy consumption, trade, urbanization and financial development: testing the EKC hypothesis for the USA. *Environmental Science and Pollution Research*, 23, 1203-1213.
- Handoyo, S., & Fitriyah, F. K. (2018). Control of corruption, regulatory quality, political stability and environmental sustainability: a cross-national analysis. *Journal of Accounting Auditing and Business*, 1(2), 28-38.
- Jamel, L., Maktouf, S., & Charfeddine, L. (2017). The nexus between economic growth, financial development, trade openness, and CO2 emissions in European countries. *Cogent Economics & Finance*, 5, 1341456.
- Jianguo, D., Ali, K., Alnori, F., & Ullah, S. (2022). The nexus of financial development, technological innovation, institutional quality, and environmental quality: evidence from OECD economies. *Environmental Science and Pollution Research*, 29(38), 58179.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2006). *Governance matters V: aggregate and individual governance indicators for 1996-2005*. (Vol. 4012). World Bank Publications.
- Khan, H., Weili, L., & Khan, I. (2022a). Institutional quality, financial development and the influence of environmental factors on carbon emissions: evidence from a global perspective. *Environmental Science and Pollution Research*, 29(9), 13356-13368.
- Khan, H., Weili, L., & Khan, I. (2022b). The role of financial development and institutional quality in environmental sustainability: panel data evidence from the BRI countries. *Environmental Science and Pollution Research*, 29(55), 83624-83635.
- Khanday, I. N., Wani, I. U., & Tarique, M. (2023). Do financial development and institutional quality matter for ecological sustainability in the long run? Evidence from India. *Management of Environmental Quality: An International Journal*, 34(6), 1668-1689.
- Lau, L. S., Choong, C. K., & Ng, C. F. (2018). *Role of institutional quality on environmental Kuznets curve: a comparative study in developed and developing countries*. In *Advances in pacific basin business, economics and finance* (pp. 223-247). Emerald Publishing Limited.
- Liao, H., Hao, G., Yasmeen, R., & Shah, W. U. (2024). Evaluation of educational resource utilization efficiency, regional technological heterogeneity, and total factor productivity change in 35 European countries. *Plos One*, 19(1), e0295979.
- Maddison, D., & Rehdanz, K. (2008). *Carbon emissions and economic growth: homogeneous causality in heterogeneous panels* (No. 1437). Kiel working paper.

- Minović, J., Stevanović, S., & Aleksić, V. (2021). The relationship between foreign direct investment and institutional quality in Western Balkan countries. *Journal of Balkan and Near Eastern Studies*, 23(1), 40-61.
- Negash, H. N. (2023). *The Role of Institutional Quality in Financial Development: An Approach towards Emerging Economies. An Approach towards Emerging Economies*.
- North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University.
- Panteli, M. e. (2022). The Impact of Institutions on Economic and Environmental Performance: Evidence From Europe. *South East European Journal of Economics and Business*, 17(2), 125-141.
- Sabir, S., Rafique, A., & Abbas, K. (2019). Institutions and FDI: evidence from developed and developing countries. *Financial Innovation*, 5(1), 1-20.
- Shah, W. U., Hao, G., Yan, H., Shen, J., & Yasmeen, R. (2024). Forestry resource efficiency, total factor productivity change, and regional technological heterogeneity in China. *Forests*, 15(1), 152.
- Shah, W. U., Wang, B., & Yasmeen, R. (2023). Evaluating the role of banking efficiency, institutions and financial development for sustainable development: Implications for Belt and Road Initiative (BRI). *Plos One*, 18(10), e0290780.
- Shah, W. U., Yasmeen, R., & Padda, I. U. (2019). An analysis between financial development, institutions, and the environment: a global view. *Environmental Science and Pollution Research*, 26(21), 21437-21449.
- Shahbaz, M., Lean, H. H., & Shabbir, M. S. (2012). Environmental Kuznets curve hypothesis in Pakistan: cointegration and Granger causality. *Renewable and Sustainable Energy Reviews*, 16(5), 2947-2953.
- Shahbaz, M., Raghutla, C., Chittedi, K. R., Jiao, Z., & Vo, X. V. (2020). The effect of renewable energy consumption on economic growth: Evidence from the renewable energy country attractive index. *Energy*, 207, 118162.
- Shahbaz, M., Shahzad, S. J., Ahmad, N., & Alam, S. (2016). Financial development and environmental quality: the way forward. *Energy Policy*, 98, 353-364.
- Tamazian, A., & Rao, B. B. (2010). Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. *Energy Economics*, 32(1), 137-145.
- Tamazian, A., Chousa, J. P., & Vadlamannati, K. C. (2009). Does higher economic and financial development lead to environmental degradation: evidence from BRIC countries. *Energy Policy*, 37(1), 246-253.
- Vatamanu, A. F., & Zugravu, B. G. (2023). Financial development, institutional quality and renewable energy consumption. A panel data approach. *Economic Analysis and Policy*, 78, 765-775.
- Yasmeen, R., Li, Y., Hafeez, M., & Ahmad, H. (2018). The trade-environment nexus in light of governance: a global potential. *Environmental Science and Pollution Research*, 25, 34360-34379.
- Zhang, Y. J. (2011). The impact of financial development on carbon emissions: An empirical analysis in China. *Energy Policy*, 39(4).